Variations in the activities of planetary-scale waves at the Venusian cloud top observed by Akatsuki UVI

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Planetary-scale waves at the Venusian cloud-top cause periodic variations in both ultraviolet (UV) albedo patterns and winds. Since planetary-scale waves are considered to play crucial roles in the momentum and material transports in the Venusian atmosphere, investigating these periodicities and its temporal change could provide a better picture of how these waves get involved in the atmospheric dynamics on Venus. In this study, we analyzed the periodicities in the UV albedo and the cloud-tracking wind variations (Horinouchi et al., 2017) derived from both 283-nm and 365-nm UVI channels observed in the OP2016 (October 2016 -- April 2017), OP2017 (June -- October 2017), OP2018A (January -- June 2018), and OP2018B (August -- December 2018). We used the successive time blocks having a time range of ±15 days extracted from the original time series and conducted Time-Shifting Lomb-Scargle (TSLS) periodogram analysis [Imai et al., 2019].

Our previous study revealed the temporal evolution of prominent 5-day waves in OP2017 for the first time, and we could find corresponding temporal changes in planetary-scale UV features. Since the reconstructed horizontal wind field had planetary-scale vortices, which was nearly equatorially symmetric and centered at ~35° latitude in both hemispheres, the observed 5-day wave can be interpreted as the equatorial symmetric Rossby wave. The amplitude of wind variation associated with the observed Rossby wave was amplified gradually over ~20 days and attenuated over ~50 days. An ~3.8-day periodic signals were observed in the zonal wind and brightness variations in the equatorial region before the Rossby wave amplification. Although the amplitude and significance of the 3.8-day mode were relatively low in the observation season, this feature is consistent with a Kelvin wave. In this observation season, there was only a small difference in the periodicities and wind field between 283-nm and 365-nm channels.

In OP2018B, we also found ~4-day and ~5-day periodicity in winds. However, the reconstructed horizontal wind field showed southwest and northeast elongated oscitation in the southern hemisphere rather than the vortices, and latitudinal asymmetry in the amplitude of wind variation was prominent. In contrast to the OP2017, ~4-day wave had relatively large amplitude to the ~5-day wave, and ~4-day wave seems gradually degraded through the observation season. While the difference in the sensing altitude of both 283-nm and 365-nm still unclear, wave signals were much clear in 283-nm channel, and these findings might indicate OP2018 was the active season for the wave excitation and the wave source was closer to the 283-nm observation altitude. In the Akatsuki observation era since the end of 2015, OP2017 and OP2018B are the representative season for investigating the evolution of planetary-scale waves. In this presentation, we will show the summary of how these two observation seasons are different and what kind of mechanisms are related to the prominence of ~4-day wave and ~5-day wave.

Keywords: Venus, Akatsuki, Planetary-scale waves